Indicators and Determinants of Food Addiction among Fourth-grade Medical Students of Minia University in Egypt

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Abstract

Background: Food addiction (FA) exists in one-sixth of Egyptian adolescents. It is associated with neuropsychiatric problems and is incriminated in the current obesity epidemic. **Objectives:** This study aimed to determine the prevalence of FA and its indicators among medical students of Minia University and to identify the predictors of FA indicators. **Method:** A cross-sectional survey of 394 medical students was conducted during November 2020. Students filled out a self-reported English questionnaire that included socio-demographics, smoking habits, modified Yale Food Addiction Scale 2 (mYFAS), Depression, Anxiety and Stress Scale-21 Items (DASS-21), and The General Practice Physical Activity Questionnaire (GPPAQ). **Results:** The prevalence of FA among the studied medical students was 11.4% and 14.5% had three or more FA indicators. The most common FA indicator was craving (24.9%) followed by withdrawal (16.2%), use in physically hazardous situations (15.2%), and unsuccessful quitting (14.7%). The significant predictors of FA diagnosis were socioeconomic level, BMI, and depression. Most FA indicators were significantly associated with depression and/or stress. Furthermore, high BMI was associated with unsuccessful quitting, giving up or reduced activities, and interpersonal problems. Smoking correlated to loss of control, craving, and clinically significant impairment. The low socioeconomic level affected the withdrawal symptoms and interpersonal problems. **Conclusion:** FA indicators are common among medical students. Future studies should evaluate the impact of nutrition education and weight control combined with smoking cessation and psychological support to promote healthy eating behavior and reduce the rate of FA and obesity among medical students.

Keywords: Yale Food Addiction Scale, medical students, Depression, Anxiety and Stress Scale-21, cross-sectional study.

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Introduction

With the rising prevalence of obesity and eating disorders around the world,[1,2] food addiction (FA) has become a popular matter of debate.[3] Repeated consumption of palatable foods mainly fats, sweets, a combination of fat/sugar, processed and/or high salt foods may trigger overeating by creating a long-term addiction-like effect on susceptible individuals.[4-6] Similar patterns of neural activation are implicated in substance dependence with elevated activation in reward circuitry in response to food cues and reduced activation of inhibitory regions in response to food intake.[7] There is a debate on the diagnosis of FA as a psychiatric disorder. As it has

been suggested that FA is a psychopathological phenomenon associated with anxiety or mood disorders, similar to substance-related, affective, and eating disorders, rather than independent psychiatric disease.[3]

FA exists among Egyptian adolescents who have a high prevalence of obesity as well.[8] A previous study in Egypt showed that the prevalence of FA among adolescents was 15.7% and the most prevalent FA symptom was tolerance found in more than half of the sample.[8] The prevalence of FA among university students ranged from 7.1% in nursing students as reported by Hong et al. 2020[9] to 18.7% among different college students as reported by Coel et al. 2017.[10] FA was expected to be higher among college students than high school students,[11] because they face more stressful life events than adolescents. University students mostly became independents and/or left their parents' home for college. They are vulnerable to develop addictive behavior like problematic internet use, smoking, and poor eating habits with high consumption of affordable and delicious fast and processed foods[12] with considerable addictive potential.[5] They may suffer from depression due to the stress of academic requirements, time pressure, and social adjustments.[13] Medical students, in particular, may face additional pressures such as the large workload, the medical curriculum, time commitment, number of assessments, and stress of clinical environment that contribute to their higher rates of depression compared to other college students of similar age.[14-16]

FA is previously correlated with higher BMI and tobacco smoking. It is a complex behavior associated with other psychiatric disorders, like depression, stress, anxiety, and sleeping problems so it may lead to dangerous health effects.[17] Therefore, FA

problem should be targeted with the efforts towards reducing food-related problems involving obesity.[6] Screening for FA and its indicators among medical students offers the opportunity for early risk identification, nutrition education to enhance healthy eating behaviors and prevent eating disorders and obesity, besides, management of the affected subjects.[18]

A recent review of FA as measured with the Yale Food Addiction Scale (YFAS) concluded that the criteria for FA need more research. Studies should assess the individual items of the scale rather than using its cut-off criteria to examine the underlying mechanisms of this behavior from a clinical perspective.[19] Another study has found that nutrition education on FA induced reduction in the rates of FA diagnosis and slight improvements in FA markers after the program.[18] Given the high prevalence of FA behavior in the literature, there is a warrant for continued research on the biological, psychological, and social factors that contribute to addiction symptoms in the preceding stages of FA to facilitate the development of early interventions. Also, it is important to promote healthy eating behaviors among medical students who aspire to care for others' health. This study aims to identify the prevalence of FA indicators and their determinants including socioeconomic state, physical activity level, and mental health problems among medical students of Minia University. Previous studies reported that medical students in the preclinical (first three) years were under higher emotional distress and had higher rates of depression, anxiety, and stress than older students in the clinical years.[20,21] In addition, extra stress and tension may be present due to the newly introduced integrated system of teaching in Minia University that may affect their

response in the study. Stress significantly decreased as the year of study increased, except for the final year.[21] Therefore, the study included fourth-grade students to represent the middle year in the faculty.

Method

Study design and participants: This cross-sectional study was carried out among fourth-year medical students in the Faculty of Medicine, Minia University during November 2020. G*Power 3.1 program (Faul et al.)[22] was used to determine the appropriate sample size. A previous study reported that the prevalence of FA among Egyptian adolescents was about 15% that was used for testing the power.[8] For logistic regression, to detect a moderate effect size of 1.5 using a two-tailed test, and to maintain a significance level of 0.05 and a statistical power of 0.80, the required sample size was calculated to be 378. All fourth-year medical students were invited to participate in the study to compensate for lack of response or incomplete data. Then 450 questionnaires were filled and returned with 90% response rate and the final sample included in the study were 394 after excluding the incomplete questionnaires.

Data collection and measures: The participating students were requested to fill a paper English version of the questionnaire under the supervision of demonstrators of public health who explained in advance the purpose and methods of the study and their right to decline to participate. The questionnaire included (1) Demographic data, including age, sex, residence and marital state, and smoking history. Smoking was defined according to the standard National Health Interview Survey (NHIS) current smoking definition. Smoker is an adult who currently smokes cigarettes and has smoked 100 cigarettes in his/her lifetime.[23]

(2) The socioeconomic scale (SES) of El-Gilany et al. 2012 which is a valid and reliable scale to assess family socioeconomic status consisting of 7 domains (education and occupation of mother and father, family domain, family possessions, home sanitation, health care, and economic domains) with a total score of 84 (a higher score indicating better socioeconomic status). The socioeconomic levels are classified depending on the quartiles of the calculated score into very low (0-21), low (22-42), middle (43-63), and high (64-84).[24]

(3) The Modified Yale Food Addiction Scale (mYFAS 2.0) is a validated tool[25] that was used to assess FA diagnosis and detect the presence of FA indictors. The measure consists of 13 self-report questions that assess 11 substance use disorder criteria of the Diagnostic and statistical manual of mental disorders (DSM-5)[26] plus clinically significant impairment/distress (assessed by two questions) representing 12 FA indicators. Each FA symptom or indicator is given a score according to the response to each question ranging from never (0) to everyday (7). Each question has a threshold, if the score for the symptom reach the threshold, then the FA indicator criterion has been met. Moreover, FA diagnosis was established if the symptom count is 2 or more plus clinically significant impairment/distress. The scale items included: larger amounts consumed and for longer periods; repeated unsuccessful attempts to quit; too much time to obtain, use, or recover; giving up social, occupational, or entertaining activities to eat; continual use despite adverse consequences; tolerance to food; withdrawal symptoms; continued use despite social/interpersonal problems; inability to fulfill main role obligation (e.g., work, school, home); use in

Table (1): Characteristics of the studied medical students according to FA diagnosis

Characteristics		Total N=394 N (%)	FA		p-value
			Yes N= 45 N (%)	No N=349 N (%)	
Age (mean±SD)		21.6 ±1.05	21.5 ±1.2	21.6 ±1.0	0.662
Sex	Male	145 (36.8)	20 (44.4)	125 (35.8)	
	Female	249 (63.2)	25 (55.6)	224 (64.2)	0.259
Marital state	Unmarried	378 (95.9)	43 (95.6)	335 (96)	
	Married	16 (4.1%)	2 (4.4)	14 (4)	0.890
Residence	Rural	212 (53.8)	23 (51.1)	189 (54.2)	
	Urban	182 (46.2)	22 (48.9)	160 (45.8)	0.700
Socio-economic level	Very low	99 (25.1)	14 (31.1)	85 (24.4)	
	Low	98 (24.9)	17 (37.8)	81 (23.2)	
	Middle	98 (24.9)	3 (6.7)	95 (27.2)	
	High	99 (25.1)	11 (24.4)	88 (25.2)	0.012
Smoking	Non-smoker	345 (87.6)	37 (82.2)	308 (88.3)	
	Smoker	49 (12.4)	8 (17.8)	41 (11.7)	0.249
Physical activity	Inactive	30 (7.6)	6 (13.3)	24 (6.9)	
	Moderate active	163 (41.4)	21 (46.7)	142 (40.7)	
	Active	201 (51)	18 (40)	183 (52.4)	0.155
BMI	18.5-24.9	258 (65.5)	22 (48.9)	236 (67.6)	
	25-29.9	110 (27.9)	17 (37.8)	93 (26.6)	
	≥ 30	26 (6.6)	6 (13.3)	20 (5.8)	0.025
DASS-21 dimensions					
Depression (total score)		20.6 ±1.05	8.7 ±4.9	5.6 ±4.3	
	Normal	167 (42.4)	10 (22.2)	157 (45)	0.000
	Mild	70 (17.8)	4 (8.9)	66 (18.9)	
	Moderate	102 (25.9)	18 (40)	84 (24.1)	
	Severe	30 (7.6)	7 (15.6)	23 (6.6)	0.001
	Extremely severe	25 (6.3)	6 (13.3)	19 (5.4)	
Anxiety (total score)		20.6 ±1.05	8.2 ±4.9	5.5±3.8	0.000
	Normal	124 (31.5)	9 (20)	115 (33)	
	Mild	43 (10.9)	1 (2.2)	42 (12)	
	Moderate	106 (26.9)	13 (28.9)	93 (26.6)	0.002
	Severe	51 (12.9)	5 (11.1)	46 (13.2)	
	Extremely severe	70 (17.8)	17 (37.8)	53 (15.2)	
Stress (total score)		20.6 ±1.05	9.2 ±4.3	6.8 ±4.2	0.000
	Normal	222 (56.3)	18 (40)	204 (58.5)	
	Mild	62 (15.7)	6 (13.4)	56 (16)	
	Moderate	67 (17)	11 (24.4)	56 (16)	0.028
	Severe	37 (9.5)	8 (17.8)	29 (8.3)	
	Extremely severe	6 (1.5)	2 (4.4)	4 (1.2)	

physically hazardous situations (i.e. distraction by eating so that the subject may be hurt as when driving a car, crossing the street, operating machinery); and craving. Additionally, clinically significant impairment/distress was present if eating behavior caused a lot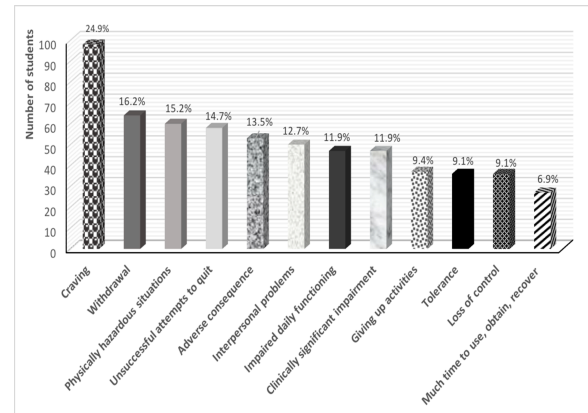 of distress and if there were significant problems in life because of food and eating.[25] (4) The General Practice Physical Activity Questionnaire (GPPAQ)[27] was included to calculate the four-level Physical activity index (PAI) which is a valid tool[28] to classify the participants into four categories:
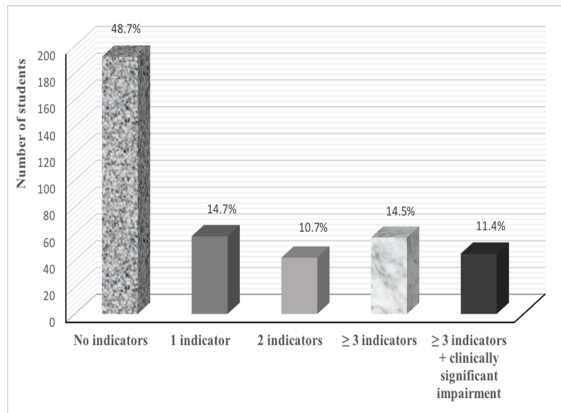
Figure (1): The number and percentage of students according to the number of reported FA indicators

Figure (2): Prevalence of FA indicators among the studied medical students

1) *Inactive* if unemployed or having a sedentary job with no physical exercise/cycling. 2) *Moderately inactive* if unemployed or having a sedentary job with <1hour physical exercise/cycling per week or standing job with no physical exercise/cycling. 3) *Moderately active* if unemployed or having a sedentary job with 1–2.9 hours physical exercise/cycling per week or standing job with <1hour physical exercise/cycling per week or physical job with no physical exercise/cycling 4) *Active* if unemployed or having a sedentary job with ≥3 hours physical exercise/cycling per week or having a standing job with 1–2.9 hours physical exercise/cycling per week or having a physical job with <1hour physical exercise/cycling per week or having a heavy manual job.

(5) Depression, Anxiety, and Stress Scale-21 Items (DASS-21) to evaluate the mental health problems of depression, anxiety, and stress during the past month. This scale includes three sub-scales (each one has 7 items): (1) Depression sub-scale which evaluates hopelessness, self-deprecation, little self-esteem, lack of interest, and low positive effect; (2) Anxiety sub-scale which assesses autonomic arousal, situational anxiety, skeletal muscle effects, and subjective experience of anxious factors; and (3)

Stress sub-scale which measures difficulty relaxing, irritability, nervous arousal, agitation, and impatience. The scale has 21 statements, and each participant should indicate how much the statement applied to him/her over the past month using a scale ranged from 0 (did not apply at all) to 3 (applied very much or most of the time). Scores of the subscales are calculated by summing the scores for the relevant items then multiplied by 2 to calculate the final score. Different degrees of emotional disorder were assigned according to the recommended cut-off scores for conventional severity labels. Depression was classified to normal (0-9), mild (10-13), moderate (14-20), severe (21-27), and extremely severe (≥28). Anxiety had normal (0-7), mild (8-9), moderate (10-14), severe (15-19) and extremely severe (≥20) degrees. Stress levels included normal (0-14), mild (15-18), moderate (19-25), severe (26-33) and extremely severe (≥34).[29, 30]

(6) Measuring the weight and height to calculate BMI as weight (kg)/height (m)^2. Participants were classified according to BMI into normal weight (18.5-24.9), overweight (25-29.9), and obese (≥30).

A pilot study was conducted among 30 participants to assess the feasibility of the study and problems with the questionnaire. Both mYFAS2 and DASS-21 showed high

Table (2): Determinants of FA indicators among the studied medical students

Indicators of FA	Predictors[*]		Adjusted OR (95% CI)	p-value
Loss of control	Smoking		2.84 (1.20-6.65)	0.016
	Depression		2.00 (1.00-4.37)	0.044
	Stress		2.23 (1.03-4.82)	0.041
Unsuccessful attempts to quit	BMI	Normal	1	
		Overweight	2.53 (1.34-4.77)	0.004
		Obese	5.51 (2.16-14.04)	0.000
	Depression		2.19 (1.16-4.14)	0.015
	Stress		2.16 (1.15-4.08)	0.017
Much time to obtain, use, recover	Anxiety		3.48 (1.29-9.38)	0.014
Giving up or reduced activities	BMI	Normal	1	
		Overweight	2.17 (1.01-4.72)	0.050
		Obese	6.12 (2.24-16.70)	0.000
	Depression		2.71 (1.32-5.60)	0.007
Adverse consequences	Depression		2.96 (1.53-5.71)	0.001
	Stress		2.19 (1.16-4.15)	0.016
Tolerance	Age		0.46 (0.31-0.68)	0.000
	Sex (male)		2.30 (1.04-5.07)	0.040
	Depression		2.69 (1.19-6.08)	0.017
	Stress		4.59 (2.07-10.19)	0.000
Withdrawal	Socioeconomic	Very low	1	
		Low	0.96 (0.48-1.92)	0.906
		Middle	0.30 (0.12-0.73)	0.008
		High	0.61 (0.28-1.33)	0.215
	Anxiety		3.85 (1.96-7.55)	0.000
Interpersonal problems	BMI	Normal	1	
		Overweight	1.48 (0.70-3.13)	0.304
		Obese	9.43(3.49-25.47)	0.000
	Socioeconomic	Very low	1	
		Low	0.28 (0.11-0.72)	0.008
		Middle	0.24 (0.09-0.64)	0.004
		High	0.49 (0.21-1.15)	0.102
	Depression		4.33 (2.03-9.23)	0.000
	Stress		2.11 (1.04-4.28)	0.038
Impaired daily functioning	Depression		2.11 (1.08-4.14)	0.030
	Stress		2.17 (1.11-4.23)	0.023
Use in physically hazardous situations	Sex (male)		2.27 (1.26-4.09)	0.006
	Stress		2.80 (1.51-5.20)	0.001
	Anxiety		2.41 (1.18-4.91)	0.015
Craving	Smoking		2.00 (1.26-3.19)	0.003
	Depression		2.04 (1.07-3.88)	0.030
Clinically significant impairment	Smoking		2.79 (1.28-6.11)	0.010
	Depression		3.24 (1.70-6.17)	0.000

 * *Depression, anxiety, and stress were used as binary variables.*

internal consistency (Cronbach's alpha value > 0.70).

Statistical analysis
IBM SPSS version 25.0 was used for statistical analyses. The significance level was $\alpha = 0.05$.
The prevalence of FA diagnosis and indicators of FA were identified in relation to sociodemographic variables and emotional problems. Continuous variables were compared using the independent-sample t-test. Categorical variables were compared using Pearson's chi-square test or Fisher's exact test, as appropriate. Binary logistic regression was used to assess the associations between each

indicator of FA and sociodemographic characteristics, physical activity level, and emotional problems. Significant factors were included in the multivariate model to calculate the adjusted odds ratios (AOR) and 95% confidence intervals (CI).

Ethical consideration

The study was approved by the ethical research committee of the Faculty of Medicine, Minia University. Verbal assent was obtained from the participating students before completing the study questionnaires.

Results

The current study included 394 medical students in Minia University, 145 (36.8%) males and 249 (63.2%) females, aged 21.6±1.5 years old (range, 20–23 years). Among the participating students, 11.4% satisfied the criteria for diagnosis with FA, 57.6% had depressive symptoms, 68.5% had anxiety, and 43.7% suffered from stress. The demographic and psychological characteristics of the studied students in relation to FA diagnosis were presented in Table 1. FA was significantly associated with the socioeconomic level, BMI, and mental health problems including depression, anxiety, and stress. Food addicted students had a lower socioeconomic level (p = 0.012), higher BMI (p = 0.025) and higher levels of depression (p= 0.001), anxiety (p = 0.002) and stress (p = 0.028). No significant differences in age, sex, marital state, residence, smoking, and physical activity were found between the two groups (Table 1). The multivariable logistic analysis showed that the significant predictors of FA behavior were socioeconomic level (AOR of middle versus very low level, 0.14; 95% CI: 0.05–0.53), BMI (AOR of obese versus normal BMI, 3.52; 95% CI: 1.20–10.28), and depression (AOR, 2.85;

95% CI: 1.34–6.06) (This data was not shown in tables).

Figure 1 showed that 14.7% of the studied medical students had one FA indicator, 10.7% had two, 14.5% had three or more, and 11.4% met the criteria for FA diagnosis. The most prevalent FA indicator was craving found in 98 (24.9%) students followed by withdrawal in 64 (16.2%), use in physically hazardous situations in 60 (15.2%), and unsuccessful quitting in 58 (14.7%) students as shown in Figure 2.

Results of multivariable logistic regression of FA indicators and sociodemographic and psychosocial correlates were shown in Table 2. Most symptoms of FA were significantly associated with depression and/or stress. Socioeconomic level significantly affected withdrawal symptoms and interpersonal problems. Smoking was associated with loss of control, craving, and clinically significant impairment. BMI was associated with unsuccessful attempts to quit, giving up/reduced activities, and interpersonal problems.

Discussion

The current study found that 11.4% of the studied medical students were meeting criteria for FA and 14.7% had ≥ 3 symptoms of FA. The prevalence of FA among college students varies in the literature from 7.1% to 18.7%.[9-11, 17, 31, 32] While, studies evaluating FA in the general population and among obese subjects showed higher prevalence rates (19.9% and 38% respectively).[33, 34] The most common FA indicators or in our study were craving (24.9%) followed by withdrawal (16.2%) and use in physically hazardous situations (15%). Craving is the typical phenomenon of addiction and with ceasing consumption of certain foods the subject suffers from withdrawal symptoms and control is lost. However, there are

different reported rates of the predominant FA indicators among adolescents[8] and university students[9] which may be due to differences in the sociocultural factors, education level, or associated behavioral problems. Generally, FA and its indicators are common among medical students who may have irregular lifestyle during involvement in lectures, clinical training, and skill development. Therefore, it is important to identify the predictors of the early indicators of addiction in the preliminary stages of FA to facilitate the development of early interventions.

Medical students usually suffer from stress during the medical education which may decrease their academic achievement and increase their risk of developing depression.[35] The current study reported that the rates of depression, anxiety, and stress among medical students of Minia University were 57.6%, 68.5%, and 43.7% respectively. While the percentages reported by Fawzy et al. 2017 whose study included medical students of Assiut University were 65%, 73%, and 59.9% respectively.[20] High levels of depression symptoms (83.4%) were also found among Saudi medical students as reported by Alharbi et al. 2018.[36] Globally, depression among medical students was highest in Africa (40.9%)[16] and anxiety was most prevalent in the Middle East and Asia.[15] On the other hand, Brazilian medical students had lower rates of depression, anxiety, and stress (30.6%, 32.9%, and 49.9% respectively) as reported by Pacheco et al., 2017.[37] Furthermore, the worldwide prevalence of depression and anxiety in medical students were 27% and 33.8% respectively.[15, 16] These findings indicate that there are relatively higher rates of depression among medical students in Egypt and Saudi Arabia than in western countries which may be due to cultural and social factors that imply more

pressure on medical students who must be excellent in all aspects of life. Also, lack of early diagnosis and effective treatment may lead to increased symptoms overtime because depression in medical students is accumulative.[38]

Numerous findings among college students indicated that females were at greater risk of FA[10, 11, 19, 31-33] and scored higher in most dimensions of YFAS than male students.[39] However, the present study and some prior research[17, 40, 41] found no significant relation of gender with FA and male students were more likely presented with tolerance and using food in physically hazardous situations than females. Such inconsistencies may exist because the samples from several studies were predominantly women[31, 33, 19] and there may be an overlap of FA diagnosis with other conditions as bulimia and anorexia nervosa which are more predominant in women than men.[42] Moreover, a recent study confirmed that the effect of sex on the YFAS score did not remain after controlling for anxiety and perceived stress.[43]

Consistent with the literature,[10,17,19,31-33,44,45] the present study found that obese students were more likely to have FA than healthy weight participants. Moreover, obesity was significantly associated with unsuccessful attempts to quit, giving up/reduced activities, and interpersonal problems which support the findings of a previous study among Egyptian adolescents.[8] On the other side, some studies failed to reveal any significant relationships between the total YFAS score and BMI.[8, 41] Since FA refers to repeated compulsive consumption of certain highly palatable foods,[44] it consequently can lead to overweight and obesity.[45] On the other side, people with higher BMI have higher frequencies of food cravings.[46] Moreover, there may be biological and hormonal

factors associated with both the body weight and the risk of FA.[47]

This study found that a higher socioeconomic level was significantly associated with lower FA risk, fewer withdrawal symptoms, and fewer interpersonal/social problems. A previous study indicated that diet quality follows a socioeconomic gradient. Whereas energy-dense foods which are usually poor in nutrients, having addictive potential, easy physical access, and low cost are preferentially consumed by persons of lower socioeconomic level.[48] A detailed study of the social factors associated with FA symptoms will allow for further evaluation of contributors to FA among medical students and young adults in general.

The current study's result is consistent with the literature, found that depression was a significant predictor of FA diagnosis among medical students and most FA indicators were significantly associated with depression and/or stress. Evidence has generally shown that mental health problems specifically depression, anxiety, and stress were significantly associated with FA.[9, 49, 50] Whereas, medical students are frequently under stress and have a high rate of depression,[16] they are prone to FA symptoms. Depression has been shown to alter food preferences, induce the overconsumption of energy-dense foods, and increase the risk of abdominal obesity.[51]

Although smoking was not a predictor for FA in the current results, it was significantly associated with loss of control, craving, and clinically significant impairment. Cigarette smoking was previously considered as an appetite suppressant, however, the physiological effect of smoking on body weight was slight and smokers had higher risks of abdominal obesity.[52] Several studies reported that smoking is a risk factor that can trigger FA[17, 53] and was associated with high frequencies of food cravings specifically high-fat foods.[54, 55] Other findings concluded that each of nicotine use and highly palatable foods stimulate the pathways responsible for reward and contribute to the development of addiction.[56] FA and tobacco use disorder share similar but not identical neurological, physiological, and behavioral abnormalities.[57] However, further research has to examine the relationship between smoking and FA and the advantage of smoking cessation on the prevalence of FA symptoms among students.

To our knowledge, this is the first study that reports the prevalence of FA and its indicators among the medical students in Egypt and Arab countries. The strengths of this study included the use of the standardized YFAS and DASS-21 which allows comparisons with results from other countries and cultures. Furthermore, the study included the evaluation of several potential confounding factors such as age, sex, socioeconomic state, smoking, physical activity level, and mental health problems. However, the study had some weaknesses. First, the cross-sectional design did not allow for the identification of directionality between FA indicators and the predictors. Second, the use of self-reported data may affect the validity and reliability of estimates. Self-reporting of mental health symptoms and smoking status may underestimate the true rates, so there may be a potential for misclassification bias. Finally, the study included students from one grade and one university, which renders it difficult to generalize the current results to all medical students.

Conclusion

In conclusion, the rate of FA among medical students was 11.4% and was predicted by obesity, depression, and low socioeconomic level. Most FA indicators were significantly associated with depression and/or stress. Furthermore, high BMI, smoking, and low socioeconomic level also affected some of FA indicators. Future studies should evaluate the effects of nutrition education and weight management programs combined with smoking cessation, psychological counseling, and effective mental health interventions to reduce the rate of FA and obesity among medical students.

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